REMARKS/ARGUMENTS

Claims 1 through 13 are currently pending in the application. Claim 1 has been amended to include the subject matter of claims 4 through 6. Consequently, claims 4 through 6 have been canceled by this amendment. Claims 11 and 13 have been amended to revise their claim dependencies in view of the cancellation of claim 4. For at least the reasons set forth below, Applicants respectfully submit that the claimed invention is patentable over the cited art.

Claims 1 through 13 stand rejected under 35 U.S.C. §103(a) as being unpatentable over U.S. Patent No. 6,342,199 to Ellis, in view of U.S. Patent Application No. 2004/0191156 to Satchell, Jr. et al. (Satchell).

Claim 1 recites a method for producing nitrogen trifluoride by contacting a fused ammonium fluoride salt with a fluorine gas. The method includes forming a stream of micro droplets of the fused ammonium fluoride salt by a rapid ejection of the fused ammonium fluoride salt in a reactor through a jet ejector pipe having nozzles. Each of the nozzles have a cross-sectional area and a throat having a throat cross sectional area, wherein the throat cross section area to the cross section area has a ratio selected from the group consisting of 5, 25, 5 through 25, and any combinations thereof. The fused ammonium fluoride salt at the nozzles has an ejecting linear velocity about 2 meters/second to about 30 meters/second.

The fused ammonium fluoride salt is circulated from a lower portion to an upper portion of the reactor. The fused ammonium fluoride salt is contacted with the fluorine gas within the stream of micro droplets. The fluorine gas is sucked in the reactor through a suction pipe for fluorine gas by a negative pressure being formed around the nozzles due to the rapid ejection of the fused ammonium fluoride salt.

The method also includes transferring a portion of the fused ammonium fluoride salt in the reactor to a second jet-loop reactor. The portion of the fused ammonium fluoride salt is rapidly ejected in the second jet-loop reactor through a second nozzle and circulated from a lower portion to an upper portion of the second jet-loop reactor. A stream of micro droplets of the portion of the fused ammonium fluoride salt is contacted with ammonia gas, that is sucked in the second jet-loop reactor by a negative pressure being formed around the second nozzle due to an ejection of the fused ammonium fluoride salt. The portion of the fused ammonium fluoride salt and the ammonia gas continuously produce nitrogen trifluoride, continuously reproduce the fused ammonium fluoride salt and recycle the fused ammonium fluoride salt reproduced in the second jet-loop reactor for nitrogen trifluoride production.

Ellis generally describes a process for conducting an equilibrium chemical reaction including a volatile reactant in a loop reactor. The loop reactor includes a reactor vessel, and a loop connected to the reactor vessel by an outlet and an inlet. It also includes a gas loop separately connected to the vessel for withdrawing and treating the volatile material circulating within the gas loop. The process further includes the steps of circulating the inert gas, feeding volatile material from the gas loop into the reactor vessel, and removing the volatile material from the reactor vessel using the gas loop. Finally, the process is repeated while also removing a volatile material to influence the equilibrium of the reaction.

Satchell generally describes a method and an apparatus for producing nitrogen trifluoride, which includes a reactor with a mixing zone, a reaction zone that communicates with the mixing zone, and a product outlet. The apparatus also includes a gaseous fluorine feed supply connected to the reactor's mixing zone, a liquid ammonium acid fluoride feed supply, and a working fluid vapor supply connected to a nozzle to a fluid vapor supply located upstream of the mixing zone of the reactor.

As conceded by the first Office Action on page 2, Applicants respectfully submit that Ellis fails to disclose or suggest a method for producing nitrogen trifluoride by contacting a fused ammonium fluoride salt with a fluorine gas. Moreover, Applicants respectfully submit that Ellis also fails to disclose or suggest the method steps of forming a stream of micro droplets of the fused ammonium fluoride salt by a rapid ejection of the fused ammonium fluoride salt in a reactor through a jet ejector pipe having nozzles, where each of the nozzles have a cross-sectional area and a throat having a throat cross sectional area, wherein the throat cross section area to the cross section area has a ratio selected from the group consisting of 5, 25, 5 through 25, and any combinations thereof, and where the fused ammonium fluoride salt at the nozzles has an ejecting linear velocity about 2 meters/second to about 30 meters/second, as recited in claim 1.

To the contrary, Ellis simply uses a loop reactor (column 3, lines 45 – 52) to conduct a chemical reaction characterized by an equilibrium. The gas loop (8) in Ellis is completely different than the suction pipe (32) for fluorine in the present invention recited in claim 1, in that the sucked gas from the suction pipe (32) is fluorine (i.e., a reactant) while the gas from the gas loop (8) in Ellis is an inert gas (i.e., not a reactant) fed for influencing the equilibrium of a reaction. Moreover, as set forth above, claim 1 recites means for increasing the rate of contact of the fluorine gas with the fused ammonium salt and suppressing the production of byproducts N_2F_2 and N_2, namely nozzles having a ratio of the throat cross-section to nozzle cross section area of 5 through 25, and the fused ammonium fluoride salt at the nozzles has an ejecting linear velocity about 2 meters/second to about 30 meters/second.

Yet another feature of the present invention recited in claim 1 that is neither disclosed or suggested by Ellis is that a portion of the fused ammonium fluoride salt in the reactor for nitrogen trifluoride production is transferred to a

second jet-loop reactor (reproduction reactor), thereby continuously reproducing the fused ammonium trifluoride salt and recycling the fused ammonium trifluoride salt reproduced into the reactor for nitrogen trifluoride production.

Therefore, Applicants respectfully submit that Ellis is deficient in disclosing or suggesting the method recited in claim 1. The Action attempts to cure one deficiency of Ellis with the Satchell reference, stating that it discloses a reaction between fused ammonium fluoride salt with fluorine gas to produce nitrogen trifluoride. Applicants respectfully disagree and assert that Satchell also fails to disclose or suggest the method recited in claim 1.

Like Ellis, Satchell also fails to disclose or suggest a method for producing nitrogen trifluoride by contacting fused ammonium fluoride with fluorine gas according to the method steps recited in claim 1. Specifically, Satchell fails to disclose or suggest the method steps of forming a stream of micro droplets of the fused ammonium fluoride salt by a rapid ejection of the fused ammonium fluoride salt in a reactor through a jet ejector pipe having nozzles, where each of the nozzles have a cross-sectional area and a throat having a throat cross sectional area, wherein the throat cross section area to the cross section area has a ratio selected from the group consisting of 5, 25, 5 through 25, and any combinations thereof, and where the fused ammonium fluoride salt at the nozzles has an ejecting linear velocity about 2 meters/second to about 30 meters/second, as recited in claim 1.

Moreover, Satchell is deficient in that it also fails to disclose or suggest that a portion of the fused ammonium fluoride salt in the reactor for nitrogen trifluoride production is transferred to a second jet-loop reactor (reproduction reactor), thereby continuously reproducing the fused ammonium trifluoride salt and recycling the fused ammonium trifluoride salt reproduced into the reactor for nitrogen trifluoride production, as recited in claim 1.

Contrary to the claimed invention, Satchell's invention merely involves passing a working fluid (HF) through a heat engine cycle and using the mechanical energy generated by the working fluid to produce sufficient mixing intensity within a nitrogen trifluoride reactor. Therefore, Satchell et al. employ a completely different means to intimately mix the reactants from that used in the present invention.

It should be noted that the claimed ratio of the throat cross section area to the cross section area selected from the group consisting of 5, 25, 5 through 25, and any combinations thereof, and ejecting linear velocity about 2 meters/second to about 30 meters/second, as recited in claim 1, are not arbitrary. As noted in the present application, the fluorine gas sucked at the nozzle by a negative pressure formed around the nozzle due to a rapid ejection of the fused salt is dispersed in the fused salt in the form of bubbles. The sizes of the bubbles depend upon the size of the nozzle and the velocity of circulating the fused salt in the loop reactor (i.e., the ejection linear velocity of the fused salt at a nozzle). The bubbles formed by ejecting rapidly the fused salt at the velocity of 2 – 30 m/sec through the nozzle having the claimed area ratio are so small that they remain in the fused salt for a long time due to their small buoyancy force while maintaining a large contact area between gas and liquid, thus accelerating the reaction while restricting the abrupt reaction with a large amount of F_2.

Additionally, since micro bubbles are homogeneously dispersed in the fused ammonium fluoride salt, the reaction is not concentrated to a specific region so that the heat generated from the reaction can be evenly dispersed, which allows a high yield of NF_3 and suppresses the production of N_2F_2, N_2, and HF, which are by-products. According to embodiments 13 to 15 of the present application (page 23, line 11 through page 24, line 15), when the circulating speed of the fused ammonium fluoride salt (i.e., the ejection linear velocity of the fused ammonium fluoride salt at a nozzle) was low, the amount of N_2 in the by-products was remarkably increased. The higher the circulating speed of the

fused ammonium fluoride salt (i.e., the ejection linear velocity of the fused ammonium fluoride salt at a nozzle), the higher were both the yield of NF_3 and the conversion of F_2. However, when the circulating speed of the fused salt was too high above 30 m/sec, it had a problem in that the foams of the fused salt were greatly generated above the surface of the fused salt so that the foams were discharged together with the exhaust gas. The reaction velocity of the present invention is high by the increased contact area between the gas and the fused salt due to the micro bubbles and thus the reaction temperature to produce NF_3 can be decreased up to 30°C. The decreased reaction temperature enables the suppression of the reaction into by-products N_2F_2, N_2, and decreases the amount of HF.

Clearly, the novel features of the claimed invention and the resultant benefits are not only absent in the cited references, they are not even contemplated. Accordingly, none of the cited art, taken alone or in combination, discloses or suggests all of the features recited in claim 1. As such, Applicants respectfully submit that claims 1 through 3 and 7 through 13 are patentably distinguishable over the cited art, and the cited combination of same. Therefore reconsideration and withdrawal of the §103(a) rejection of these claims, and passage of this application to allowance, are respectfully requested.

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Respectfully submitted,

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